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2. Patent application number *(The Patent Office will fill in this part)* — 0326365.4 — 12 NOV 2003

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5621 BA EINDHOVEN
THE NETHERLANDS

Patents ADP Number (*if you know it*) — 07419294001

If the applicant is a corporate body, give the country/state of its incorporation — THE NETHERLANDS

4. Title of the invention — A RADIO COMMUNICATION SYSTEM, A METHOD OF OPERATING A COMMUNICATION SYSTEM, AND A MOBILE STATION

5. Name of your agent (*if you have one*)

"Address for service" in the United Kingdom to which all correspondence should be sent (*including the postcode*)

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Redhill
Surrey RH1 5HA

Patents ADP number (*if you know it*) — 08359655001

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Country	Priority Application number	Date of filing

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Continuation sheets of this form	
Description	5
Claims(s)	2
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DESCRIPTION

A RADIO COMMUNICATION SYSTEM, A METHOD OF OPERATING A COMMUNICATION SYSTEM, AND A MOBILE STATION

The invention relates to a radio communication system, a method of operating a communication system, and a mobile station for use in a communication system.

In a radio communication system comprising base stations of fixed location and mobile stations, transmissions from a base station to a mobile station take place on a downlink channel and transmissions from a mobile station to a base station take place on an uplink channel. It is known to use downlink closed loop transmit power control in which a mobile station measures the quality of a received power controlled downlink pilot signal and transmits transmit power control (TPC) commands to a base station so that an adequate, but not excessive, received signal level is maintained at the mobile station despite fluctuations in downlink channel conditions. It is also known to use uplink closed loop transmit power control in which a base station measures the quality of a received uplink pilot signal and transmits transmit power control (TPC) commands to a mobile station so that an adequate, but not excessive, received signal level is maintained at the base station despite fluctuations in uplink channel conditions.

When a plurality of mobile stations share a channel, separate TPC commands are provided for each active mobile station because each mobile station will experience unique channel fluctuations. Similarly, a separate pilot signal is provided for each active mobile station; each mobile station demodulates its respective pilot signal to estimate the channel characteristics prevailing for that mobile station and optionally to generate a phase reference. The estimated channel characteristics and the phase reference are then used to assist demodulating information carrying signals. The pilot signals comprise

predetermined data values to enable a mobile station readily to determine distortion introduced by the channel.

The pilot signals and the signals conveying the TPC commands are subject to transmit power control.

The transmission of the pilot signals and the TPC commands uses system resources. For example, in a Code Division Multiple Access (CDMA) system channel codes are required for each pilot signal and TPC command, and in a Time Division Multiple Access (TDMA) system time slots are required for each pilot signal and TPC command.

An object of the invention is to reduce the requirement for system resources.

According to a first aspect of the invention there is provided a mobile station for use in a communication system having a base station, comprising
receiver means for receiving from the base station a first downlink signal,
measurement means for measuring a parameter of the received first downlink signal,
power control means for generating first power control commands in response to the measured parameter, and
transmitter means for transmitting the first power control commands to the base station,
wherein the measurement means is adapted to measure the parameter of the first downlink signal while first downlink signal is modulated with non-predetermined data values and is subjected to transmit power control in accordance with the first power control commands.

According to a second aspect of the invention there is provided a radio communication system comprising a base station and at least one mobile station in accordance with the first aspect of the invention.

According to a third aspect of the invention there is provided a method of operating a communication system comprising a base station and at least one mobile station, comprising

at the base station, receiving first power control commands transmitted by the mobile station and transmitting a first downlink signal modulated with non-predetermined data values and subjected to transmit power control in accordance with the first power control commands, and

at the mobile station, receiving the first downlink signal, measuring a parameter of the first downlink signal modulated with the non-predetermined data symbols, generating the first power control commands in response to the measured parameter, and transmitting the first power control commands.

The invention is based on the realisation that downlink closed loop power control may be operated by measuring the quality of received downlink non-predetermined data symbols instead of predetermined pilot symbols, and that in some circumstances, separate pilot signals are not necessary for channel estimation. In some circumstances, downlink channel estimation is not required at all, and in other circumstances a common downlink pilot signal transmitted at a constant power level may be used instead of separate pilot signals. Consequently, operation is possible using fewer downlink system resources.

Optionally, the non-predetermined data symbols used for measuring the quality of a received signal for downlink closed loop power control may convey downlink TPC commands used for uplink power control.

The invention will now be described, by way of example only, with reference to the Universal Mobile Telecommunication System (UMTS).

One application for the invention is the UMTS Frequency Division Duplex (FDD) mode in Release 5 of the UMTS Specifications, in which it is possible to operate High Speed Downlink Packet Access (HSDPA) in such a way that a downlink dedicated channel is not needed for data (user or signalling), as this can be sent via the High Speed Downlink Shared Channel (HS-DSCH). In this case a downlink Dedicated Channel (DCH) is still required to transmit TPC commands.

The existence of a downlink DCH requires the allocation of a channelisation code for the duration of the connection. One way of operating the downlink DCH is to configure it as a fractional DCH which comprises only pilot symbols and TPC commands, with multiple users multiplexed on to the same code. Such a scheme frees up channel codes which can be used to increase system capacity. However the present invention requires even fewer resources.

The requirement is for the mobile station to be able to derive a power control command to send in the uplink. This will then be used by the base station to adjust the power of the part of the fractional DCH corresponding to that mobile station.

The invention is based on the recognition that separate pilot symbols for each active mobile station are not necessary in at least two cases:

1) Where the DCH is transmitted using a common pilot signal as a phase reference, for example by using the same antenna(s) and antenna weights as the common pilot signal assigned to the DCH. In this case the radio channel can be estimated from the common pilot signal and this can be used to demodulate the TPC bits.

2) Where different antennas or antenna weights are be used for the common pilot signal and the DCH, but the correlation between them is sufficiently good that the common pilot signal can be used to make a reasonable channel estimate for the DCH, such that it can be received reliably. The first case is very likely to apply in HSDPA, as the HS-DSCH will be assigned a common pilot signal as a reference. The same common pilot signal can be used for the fractional DCH. Since the total power used by fractional DCH's is not likely to be very large, the benefits of separate antenna beamforming for fractional DCH will not be large.

So, according to the invention the downlink fractional DCH can consist only of non-predetermined information bits multiplexed between users. A special case of particular interest is where these information bits carry TPC commands. The amplitude of individual TPC bits may be adjusted by the base station according to power control commands received from the relevant

mobile station. The mobile station should determine the radio channel phase characteristics from an appropriate common pilot signal, demodulate the TPC command and increase or decrease the mobile station uplink DPCCH power as required. In addition, the mobile station should use the amplitude of the received TPC bits to determine any TPC commands sent in the uplink.

The decision threshold for TPC commands sent in the uplink can be determined by setting a particular error rate requirement for the TPC commands received in the downlink. This is contrast to current practice which is to set a performance target based on the average signal to noise ratio or frame error rate of a data channel.

One application for the invention is a fractional control channel in UMTS FDD mode. With spreading factor 256 there are 10 symbols per slot. This can conveniently support either 2, 5 or 10 users with 5, 2 or 1 symbol per TPC command respectively.

In another application of the invention the spreading factor would be 128, which would more easily support the use of Space Time Transmit Diversity (STTD) applied to groups of two symbols.

Signalling is needed to assign mobile stations to use a particular code and timeslot, in order to align the uplink and downlink power control timing.

Optionally, by avoiding the need to transmit a separate pilot signal for each user, the energy that would have been used to transmit the separate pilot signals can be redeployed by increasing the number of symbols used to transmit the TPC commands.

In the present specification and claims the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. Further, the word "comprising" does not exclude the presence of other elements or steps than those listed.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the art of mobile communications and which may be used instead of or in addition to features already described herein.

CLAIMS

1. A mobile station for use in a communication system having a base station, comprising

receiver means for receiving from the base station a first downlink signal,

measurement means for measuring a parameter of the received first downlink signal,

power control means for generating first power control commands in response to the measured parameter, and

transmitter means for transmitting the first power control commands to the base station,

wherein the measurement means is adapted to measure the parameter of the first downlink signal while first downlink signal is modulated with non-predetermined data values and is subjected to transmit power control in accordance with the first power control commands.

2. A mobile station as claimed in claim 1, wherein the receiver means is adapted to receive from the base station a second non-power controlled downlink signal and to derive a channel estimate from the second downlink signal, and to employ the channel estimate to decode the first downlink signal.

3. A mobile station as claimed in claim 1 or 2, wherein the non-predetermined data values comprise second power control commands and the power control means is adapted to decode the second power control commands and to adjust the transmit power of the transmitter means in accordance with the decoded second power control commands.

4. A radio communication system comprising a base station and at least one mobile station as claimed in any of claims 1,2, or 3.

5. A method of operating a communication system comprising a base station and at least one mobile station, comprising

at the base station, receiving first power control commands transmitted by the mobile station and transmitting a first downlink signal modulated with non-predetermined data values and subjected to transmit power control in accordance with the first power control commands, and

at the mobile station, receiving the first downlink signal, measuring a parameter of the first downlink signal modulated with the non-predetermined data symbols, generating the first power control commands in response to the measured parameter, and transmitting the first power control commands.

6. A method as claimed in claim 5, comprising at the base station, transmitting a second downlink signal at a constant power level, and at the mobile station, receiving the second signal, deriving a channel estimate from the second downlink signal, and employing the channel estimate to decode the first downlink signal.

7. A method as claimed in claim 5 or 6, comprising at the base station, arranging for the non-predetermined data values to comprise second power control commands and, at the mobile station, decoding the second power control commands and adjusting the transmit power of the mobile station in accordance with the second power control commands.

ABSTRACT

A RADIO COMMUNICATION SYSTEM, A METHOD OF OPERATING A COMMUNICATION SYSTEM, AND A MOBILE STATION

In a mobile communication system comprising a base station and a plurality of mobile stations and operating closed loop transmitter power control, power control commands for transmission on an uplink are derived from measurements made on received downlink signals comprising non-predetermined data symbols. Optionally the non-predetermined data symbols may comprise power control commands for uplink transmit power control.

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